Space Weather Technical Forecast

Issued on Tuesday, 12 April 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Increasing chance of G1/Minor Geomagnetic Storms through the period, becoming likely by Day 3 (14 Apr). Chance of Active fluence developing by Day 3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with a filament eruption from a plage region near south centre disc giving a C1 flare at 11/0521 UTC. This eruption produced an Earth directed CME with a full halo showing in SOHO coronagraph imagery. There is now one sunspot region on the Earth-facing disc located on the northeast quadrant. AR2983 has faded and is no longer visible, as it recently crossed the northwest limb with another C1 flare observed at 11/1830 UTC from this region.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was indicative of an ongoing HSS from CH72. The wind speed varied between 450-550 km/s, with a slow decline observed. The density has been average and is now at below average levels. The interplanetary magnetic field (IMF), Bt, was mostly weak throughout the past 24 hours. The north-south component, Bz, ranged between +/-6 nT, and has been largely southward directed. The Phi angle has been predominantly negative (towards the Sun). Geomagnetic activity has been Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy (greater than 2MeV) electron flux started the period at normal background levels, before becoming Moderate from around 11/100 UTC, and probably remained below the active level however there was a 4 hour data outage after 11/1600 UTC. The corresponding 24-hour fluence rose after 11/0600 UTC to reach an observed value of 2.22e7 integrated pfu observed at 12/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Very Low, with only one small and simple sunspot on the disc. There remains a Slight Chance for further C-class flares through the forecast period.

Solar Wind / Geomagnetic Activity: There is the possibility of a weak CME arrival early on Day 2 (13 Apr), from a filament liftoff on 9th. A second, probably stronger CME from a filament eruption occurred early on 11th. This feature has been analysed to be Earth directed with an arrival on Day 3 (14 Apr). Current HSS effects from CH72 are giving slightly elevated solar wind speeds, expected to continue Day 1 (12 Apr) with a slow decline forecast through much of the period.
Geomagnetic activity is forecast to be Quiet to Unsettled with a Chance of Active intervals on Day 2 (13 April) and a Chance of G1/Minor Storms. The risk of G1/Minor Storms becomes more likely on Day 3 (14 April) with a slight chance of a G2/Moderate Storm as the anticipated second CME from 11 April arrives

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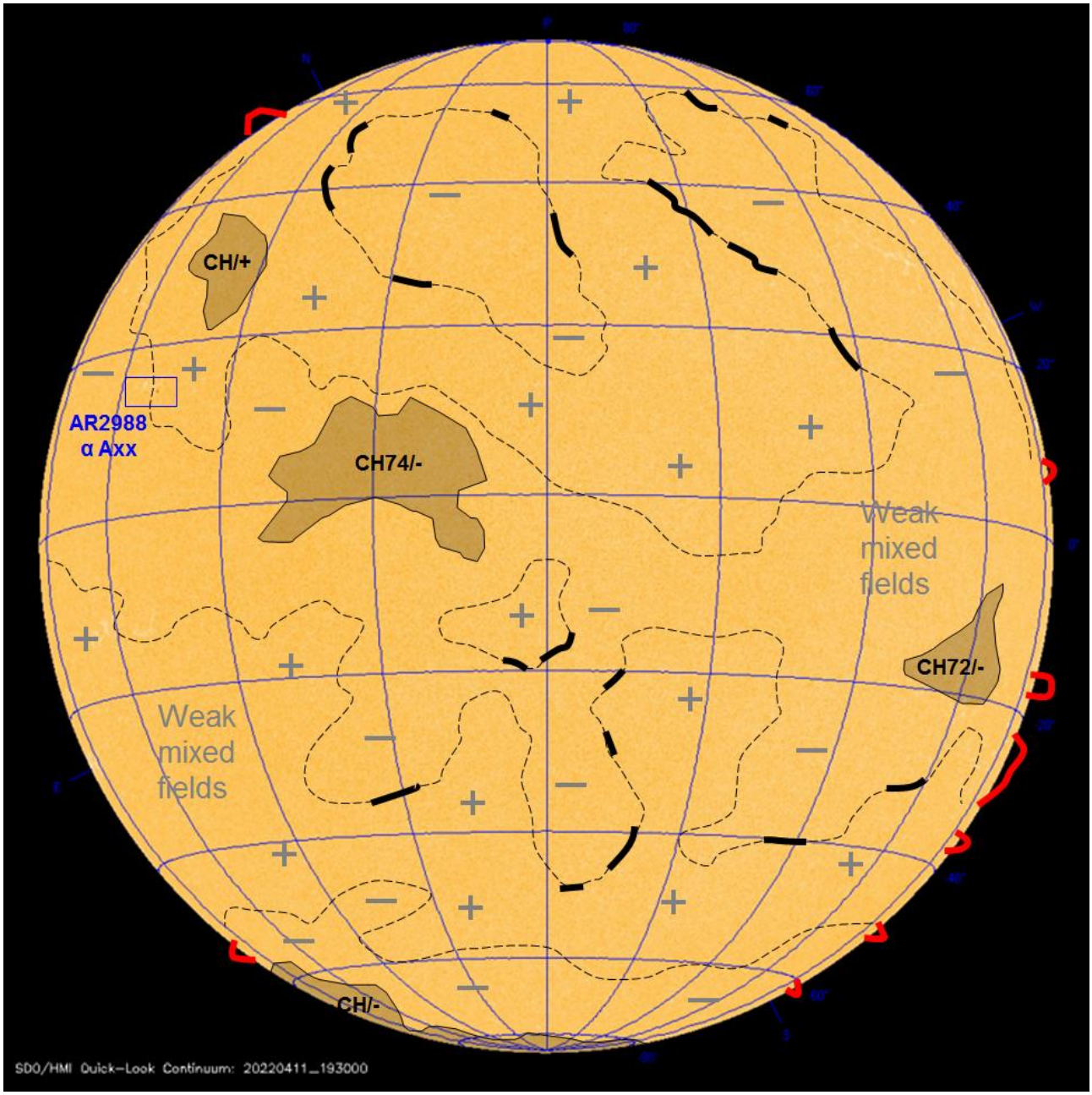
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. The high energy (greater than 2 MeV) electron flux is forecast to start at background levels, probably rising to reach High levels on Days 1 and 2 (11-12 Apr), although the CME arrivals might suppress levels temporarily on Day 2 (13 April) and more especially during Day 3 (14 April). The associated 24 hour fluence is likely to remain below the Active threshold throughout the period, but with a rising trend through the period.

Figure 1. Solar Analysis Valid 2000 UTC, 11 April 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A large filament in the southwest of the disc lifted off on 9th Apr. The associated CME was largely southward directed, but there appears to be some ejecta earthbound on LASCO C2/C3 imagery, and Met Office ENLIL model output indicates a possible glancing blow. If this CME arrives, it is currently anticipated to occur on Day 3 (13 April). A second, probably stronger and more Earth-directed CME from a filament eruption occurred early on 11 April. This feature is due to arrive on Day 4 (14 Apr).

Current HSS effects from CH72 are giving slightly elevated solar wind speeds at L1. This feature is expected to continue to give slightly elevated wind speeds through Day 1 (12 Apr) with a slow easing expected. The magnetic field has now reduced to weak levels again, which reduces the chance of any G1/Minor Storm intervals.

Geomagnetic activity is forecast to be Quiet to Unsettled, with a slight chance of G1/Minor Storms on Day 1. There is also a Chance (40%) of G1/Minor Storms on Day 2 should the CME from 09 April give a glancing blow. Following this on Day 3 (14 April) Active to G1/Minor Storm becomes likely with a slight chance (10%) of G2/Moderate Storm on arrival of the second CME that departed the sun on 11 April. Activity then is likely to mostly return Quiet to Unsettled on Day 4 (15 April).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	40	70	10
Strong	G3	No	1	1	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/2010	Partial	Filament	SW	500	13/0100	Glancing blow possible
11/0521	Full halo	Filament	South centre disc	500	14/1200	Limited shock expected

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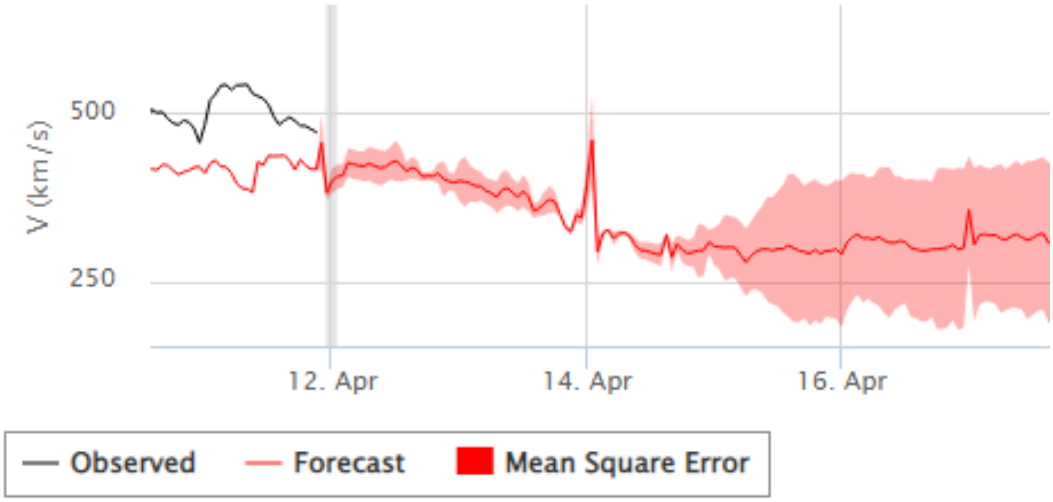
Figure 2: Met Office Solar Winds Prediction Model showing a decline in coming days.



Radio Blackouts - X-Ray Flares:

There is now one sunspot region on the Earth-facing disc. AR2983 has now faded and has recently disappeared from view across the northwest limb. It will contribute a small amount to flare probabilities until it is further over the limb The new region (2988) in the northeast quadrant is a small and simple Axx/Alpha region.
Recent activity has been Low, with a C-flare associated with a filament eruption from a plage region near south centre disc and the C-flare from 2983. Any future activity is likely to be Very Low with only one small sunspot region on the disc. One further possible region may rotate onto the southeast limb in the coming days, but it doesn't currently look particularly active in STEREO-A imagery.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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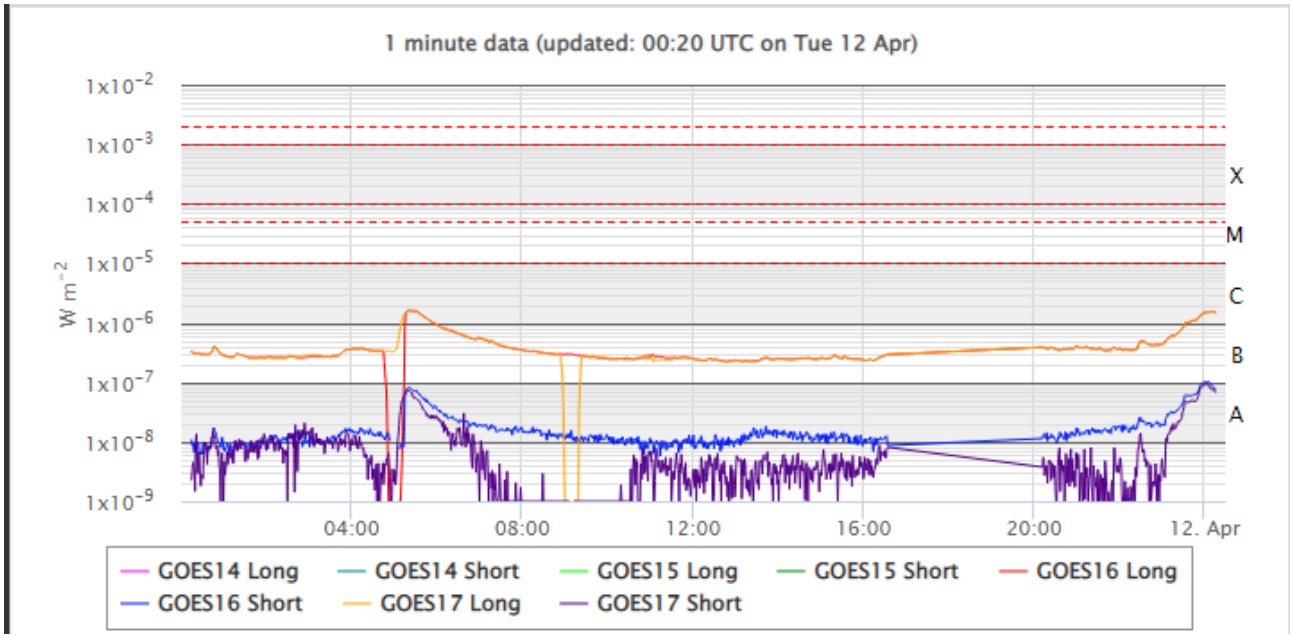
Figure 3: X-ray flux plot at GEO showing the C-class flare early on Monday (11 April) and a very recent flare, probably from AR2978.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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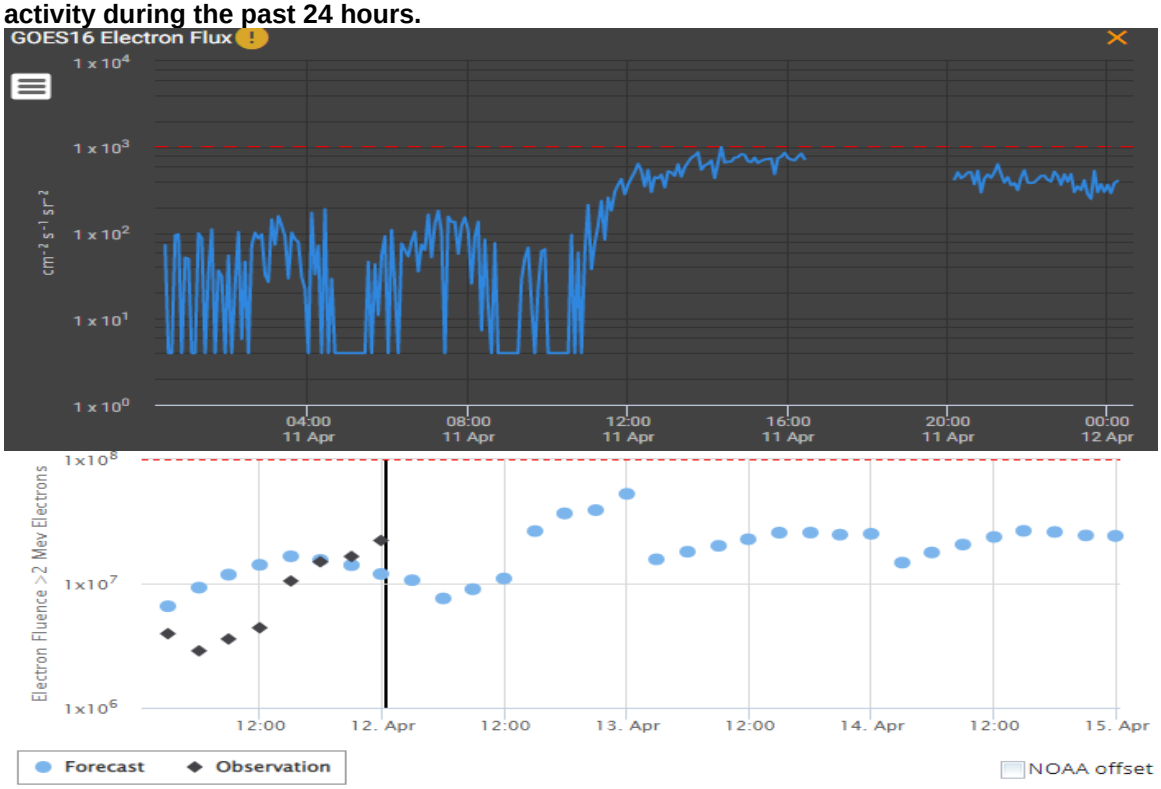
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV), as observed by GOES-16 at GEO, started the day at normal background levels before becoming Moderate as the effects from the current HSS wane, and the radiation belts decompress with electron charging to raise flux levels which will probably reach High levels during Days 1 and 2 (11-12 Apr). although the CME arrivals might suppress levels temporarily on Day 2 (13 April) and more especially during Day 3 (14 April).

The associated 24 hour fluence is below the Active (1e8 integrated pfu) threshold and is likely to remain below through the forecast period, although a rising trend will probably continue. Temporary slight declines may occur at times in response to potential CME effects before a possible resumption in the upward trend. Met Office REFM output will not be taking account of CME effects, although now appears to have assimilated the effects of the HSS. As such it is now showing a rising trend below the Active threshold, which is reasonable guidance, but won't be taking account suppression due to the anticipated CME arrivals on Days 2 and 3 (13 and 14 April)..

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	20	30	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: High energy electron flux at GEO and Met Office REFM output showing an increase in activity during the past 24 hours.



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